DOCUMENT RESUME

ED 329 155 HE 023 917

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TITLE Applied Science as Revolutionary Reform in Nicaraguan Higher Education.
PUB DATE Aug 90
NOTE 27p.
PUB TYPE Reports - Descriptive (141) -- Historical Materials (060)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Case Studies; Developing Nations; Economic Change; Foreign Countries; Higher Education; Ideology; *International Cooperation; *International Educational Exchange; International Relations; Natural Sciences; Political Issues; Postsecondary Education; *Science Education; Social Change; Technology
IDENTIFIERS Agency for International Development; *Educational Reform Program; Latin American Scholarship Prog of Amer Univs; *Nicaragua; United States

ABSTRACT

This study examines a Nicaraguan educational reform movement, initiated at universities located in Managua and Leon, which sought to promote social and economic change and the practical use of the natural sciences at the undergraduate college level. The study identifies major stakeholders in these science reform efforts and their diverse ideological orientations; and describes in detail the planning, implementation, and evaluation of the reform. Also included are assessments of the project goals, activities, linkages, and outcomes. Four ideological perspectives held by reform participants, or stakeholders, are heuristically represented; and the usefulness of a critical pragmatic approach to educational reform explanation is discussed. The study begins with a description of the research framework. Next, the historical and economic background of the relationship between Nicaragua and the United States is presented, followed by a discussion of the state of education in Nicaragua prior to and after the 1979 revolution. Finally, the creation of the Latin American Scholarship Program of American Universities is explained, its implementation described, its outcomes (problems and achievements) listed, and its implications for development theory and practice considered. Contains 45 references. (GLR)

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APPLIED SCIENCE AS REVOLUTIONARY REFORM IN NICARAGUAN HIGHER EDUCATION

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August, 1990

HE 023 917

U.S. DEPARTMENT OF EDUCATION
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ABSTRACT

In 1979, Nicaraguan revolutionaries drew upon Sandino's earlier struggle and ideological pluralism to begin their program for popular empowerment and structural renewal. Rejecting Marxist-Leninist orthodoxy, Sandinistas focused on the requirements of reform practice. This study describes a four year educational reform collaboration where a U.S. government agency and NGO provided applied science projects to Nicaraguan universities in Managua and Leon. Project goals, activities, linkages and outcomes are assessed. Four ideological perspectives held by reform participants, or stakeholders, are heuristically represented; and the usefulness of a critical pragmatic approach to educational reform explanation is discussed.

"I will not abandon my struggle while my people have one right yet to win. My cause is the cause of my people, the cause of America, the cause of all oppressed people."

Augusto César Sandino

Introduction

This study examines a case in Nicaragua in which an educational reform sought to promote social and economic change, and the practical use of the natural sciences at the undergraduate college level. The educational reform followed as a key element in the major political transformation put in motion by the Sandinista revolution of 1979. This radical break was brought about by an ongoing desire for a more equitable society and division of resources, and an end to the United States' chronic military and political presence (LaFaber, 1984; Marcus, 1985).

Research Framework

Both world and national systems perspectives as Ginsburg (1990) argues may be valuable for contextualizing reform in geographical and historical space and time. However, they may need to be supplemented with a focus on reform practice, as in this study seeking to "explain" university reform in the specific context of Nicaraguan revolutionary transformation. A dependent system had been intact for decades prior to the 1979 revolution. The power shift which took place then presented the possibility for breaking Nicaragua's long economic dependency on the United States and for creating a place for applied science within the educational curriculum. Here a world system explanation is compelling.

In contrast, our analysis of reform in higher education is based

on a radical humanist and critical pragmatic framework. The "radical humanist paradigm", exemplified by Sandino's opening quote has more recently been defined by Burrell and Morgan (1979:32), as a:

> frame of reference [which] is committed to a view of society which emphasizes the importance of overthrowing or transcending the limitations of existing social arrangements . . . . [T]he radical humanist places most emphasis upon radical change, modes of domination, emancipation, deprivation and potentiality.

Our perspective is critically pragmatic in the sense that meaning is seen to be constructed within the practice of reform and in the context of crisis (Paulston, 1990). While we do not dismiss Marxist grand theory seeking to frame and drive explanation - or any other metatheoretical myth divorced from reform practice for that matter, we would argue that a critical pragmatic perspective, because it accepts and assesses all arguments in light of what works in practice and what crisis requires, provides for more contextualized explanations, and accordingly, has greater utility for practical action.

While this approach may furnish a basis for comparison and reflection it does not provide a universal explanation for all cases involving the United States and Latin America. The present study must be viewed as an event within a specific setting. Different governments, time frames, and world views will engender their own specific issues and meanings (Paulston & Tidwell, 1991). The degree of lasting change in the structure and values of this attempted reorientation to applied science also remains to be seen. Short-term beneficial effects of the

Latin American Scholarship Program of American Universities (LASPAU) science project are evident, even amidst the destruction waged by U.S.-funded counter-revolutionary forces. Whether the modified curriculum remains in place with continued maintenance of the laboratories and equipment, and whether university students are willing to choose applied science careers instead of more traditional studies in law and philosophy remains to be seen. (Aiges, 1986c).

In this paper our objectives are to identify major stakeholders in the science reform efforts and their diverse ideological orientations; to describe in detail the planning, implementation, and evaluation of the reform; and to draw some implications for development theory and practice. Our notion of ideology is broad, i.e. it covers ideas, including theories, reflecting the social needs and aspirations of individuals, groups, and classes. It is the ideational problematic brought to action, and the practical result of critical reflection on action.

Historical and Economic Background

Since the 1850s, economic exploitation by U.S. business interests in Nicaragua helped to establish and maintain a dependent economic system. Later, in the 1920s and 1930s, problems of political and economic instability were used as a rationale to send U.S. military forces to Nicaragua where they stopped Sandino's guerrilla war against U.S. domination.

Nicaragua's dependent relation with the United States reached an apex during the subsequent Somoza family reign from 1934 to 1979. During this time, the poorest 50% of the nation's workers received 15%

of the nation's total income, while the wealthiest 20% received 60 percent. The Somoza family alone owned approximately 20% of the nation's land and industrial wealth (Arnove, 1986). Neither the Samoza government nor the business interests expressed the slightest concern to raise living standards for the masses through education (De Castilla, 1972). According to Black and Bevan (1980: 6) the 1979 revolution put an end to an oppressive government "installed and supported by the USA for half a century; a government which served foreign interests, and those of the Somoza family, rather than those of the Nicaraguan people".

Education in Nicaragua Before and After the 1979 Revolution

Before 1979, the educational system clearly mirrored Nicaraguas' dependent status. While the constitution guaranteed free and compulsory primary education for all children, facilities remained class-linked, urban and largely underdeveloped (Consejo Superior, 1965). As in many Latin American countries, the Nicaraguan government provided extensive education at the public expense to children of the urban elites, but very little primary education or basic literacy to children in the rural majority (Carnoy and Torres, 1990: 321). Illiteracy ran approximately 50% in urban areas and 75% in rural areas. Only 65% of the school-aged children actually enrolled and attended school. Of those children entering school, about 20% would complete sixth grade. The fact that only about 15% of the high school-aged population attended school gives an indication of the small number prepared academically for higher education (Arnove, 1986).

Traditionally, Latin American higher education offers professional

studies in the humanities, philosophy, and law, relying primarily on lecture and rote learning. The strong emphasis on theoretical and philosophical studies has been largely unrelated to manpower requirements, and positions required for economic and technological development have typically lacked qualified candidates (DeCastilla, 1972). Since applied sciences found few supporters, laboratories and opportunities for practical experience and extension within the academic setting rarely existed (Castrejon D. 1975). Even at the Universidad Centroamericana (UCA), located in Managua and established in 1960 to provide personnel for industrialization, more students enrolled in business administration and economics than in engineering, technology, or agriculture programs (Tunnerman, 1976; UNAN, 1977).

The Sandinista National Liberation Front (FLSN), which came to power in 1979, dedicated education to shape the "new person" or selfless Sandinista revolutionary. Guidelines for the new educational policy called for (1) participatory education for the masses; (2) adult education; (3) the elimination of illiteracy; (4) educational innovation for scientific and technical fields, linking education to productive work; and (5) the transformation of education to support the new economic and social model (Borge, 1983; E. Cardenal, 1980; Fonseca, 1980). Higher education would help the country emerge from the dependent capitalistic system of the old regime, and address three new priority areas of the revolution: medical science, formal education, and land reform (Consejo Nacional de la Educacion Superior, 1980; Tunnerman, A., 1980).

Initial efforts by the Ministry of Education to make education

correspond to ideals of the revolution included a literacy campaign which reduced illiteracy by approximately 35 percent, the establishment of ongoing adult basic education, a 100% increase in school enrollment, teacher salary increases of 50 to 100%, the establishment of a national textbook industry, the revision of curricula, and the use of more participatory instructional methods (Borge, 1980; Cardinal and Miller, 1981; Ministerio, 1980).

Higher education, under the Sandinista regime, became critically involved in meeting the resource needs of the country. Enrollments in agricultural science, medical science, educational science, and technology increased by 15 to 18%, while enrollments in humanities declined by almost 35%. The Universidad Nacional Autonoma de Nicaragua (UNAN), located in Leon, became a center for natural and physical sciences, while The private Catholic university (UCA) in Managua specialized in the humanities, law, and public and business administration (Dettmer, 1983).

The shift from elite domination of a powerless majority to their empowerment with guns and ballots also presented the possibility for developing greater economic independence. This would be facilitated by applied science programs at the university level. In developing applied research programs, the Nicaraguan government had little if any experience and sought the help of knowledgeable but non-paternalistic collaborators with resources and technical skills (Aiges, 1986a).

The Creation of the IASPAU/AID Project

Since 1966 IASPAU, with funding from the United States Agency for International Development (USAID) had provided scholarships to Nicaraguan

university faculty for training at university graduate programs in the United States. Over the years, LASPAU built a successful program and strong rapport with the Nicaraguan university staff. In 16 years, 79 LASPAU/AID scholarships had been granted to UNAN and UCA faculty and administrators (Paulston and Henderson, 1984). At the request of the U.S. Embassy in Nicaragua, LASPAU reestablished their relationship with Nicaraguan universities in 1979. LASPAU staff met with USAID officials and the rector of UNAN to discuss possibilities for AID/LASPAU contributions to revolutionary university reforms then in the planning stage.

For a number of reasons, the practice of sending Nicaraguan faculty to the U.S. was not practical. With a new open enrollment policy, the university student population had doubled and faculty shouldered excessive teaching loads. The Nicaraguan government had funded 300 scholarships to send students abroad to study fields that corresponded to production needs (i.e., forestry, farming mechanical engineering, textiles, electricity, chemistry, hydraulics, geology and mines, marine biology, and fishing (Consejo Nacional de la Educacion Superior, 1980), but this did little to reduce enrollment pressure.

Consequences of rapid enrollment expansion in higher education were also exacerbated by the fact that approximately one-third of the most highly qualified full-time university professors had either resigned to work in the revolutionary government, or had fled the country with the fall of the Somoza regime. The direct hire of thirty-seven primarily Marxist professors from Mexico, Cuba, and Venezuela helped to fill some positions, but given explosive enrollment growth, faculty shortages

persisted (Rojas, 1982). As staff shortages made it difficult for the administration to grant sabbatical leaves for professors to study in the United States, the rector of UNAM suggested that a few professors might be granted scholarships for study in the United States if they could be replaced by professors chosen by Nicaraguan University authorities from U.S. universities.

As a result of discussions beginning in 1979 the Nicaraguan and United States governments agreed to collaborate. LASPAU, with funding from USAID, would create a reform project in applied science at two of Nicaragua's universities (UCA and UNAN). Over the period from 1981 to 1983, visiting U.S. professors would teach science and conduct applied research in nutrition, aquaculture, forestry, and medical and ecological biochemistry, i.e., areas identified by Nicaraguan university authorities as critical for national development and human welfare.

The LASPAU/AID project in Nicaragua is also noteworthy as a planned, systematic break with the weak science tradition in Latin American higher education (Palmer, 1984; Segal, 1987). It provided a small scale, practical, participatory activity with immediate application. The attempt at change was not only structural, i.e. concerned with restructuring departments, curriculum, laboratories and the like, but was also value oriented. Project goals sought a widespread application of science and technology as a necessary conditon for success in achieving revolutionary goals for liberation and progress (Paulston and Henderson, 1983: 13).

The LASPAU project also offered the possibility for the governments of the United States and Nicaragua to work together in a way agreeable

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and beneficial to both parties. Immediately following the revolution, US policy toward Nicaragua sought to limit Marxist influence and strengthen centrist political elements in the ruling revolutionary alliance (Leogrande, 1985). Willing to compete with many varieties of Marxist thought in Nicaragua, the Carter Administration sought out opportunities to advance democratic ideals as well as technological development. While concerned with a growing Cuban presence, Ambassador Pezzullo commented at the time, that Nicaragua and the Sandinistas presented "an acceptable model" of revolution (Leogrande, 1985: 427).

For the Nicaraguans, the project, under full LASPAU administration would bring technical assistance without domination. The program offered greater health and production to the nation through improved science education linked with practical application largely in rural areas (Tunnerman, 1980b).

The project also addressed the expectations of other major stakeholder groups. For LASPAU, the project offered an opportunity to reconfirm a trusted relationship and respond to the faculty development needs of Nicaraguan universities with an on-site reform. The two university campuses eagerly accepted the opportunity to build stronger science programs in coordination with the revolutionary government's agenda for human and national development. And U.S. professors would have rich opportunities to develop and apply their specialized skills and advance their careers while initiating new and useful programs.

By early 1980, after several months of negotiation and planning, AID officials, administration and staff from the universities, and LASPAU staff had hammered out mutually acceptable goals and objectives. The

request for proposals distributed by USAID, framed in a modernization theory perspective, also addressed the manpower goals of the new Nicaraguan government: i.e., to "improve the quality of education in Nicaragua . . . by expanding the pool of skilled technical expertise available for national development needs through training of university students," and specifically to "assist the Nicaraguan universities to develop more highly trained manpower in priority fields for national development" (Paulston and Henderson, 1983:45). For the exchange, LASPAU recruited 10 young U.S. university professors actively engaged in science teaching, research, and development in U.S. universities. The professors needed to be open-minded and collaborative, but not highly politicized. As direct hire Nicaraguan university employees, they were to see themselves as colleagues and equals to the Nicaraguan professors, rather than AID employees or privileged outsiders.

LASPAU, a non-governmental organization or NGO, had complete operational control of the project, the trust of Nicaraguan government officials, and drew upon an extensive network of U.S. and Latin American academic contacts. After a lengthy screening and selection process, LASPAU recruited 10 professors who were then successfully vetted by the Nicaraguan project directors. Of these ten, eight stayed the full length of the project: one returned to the United States early, and another died in an automobile accident at Leon, to be buried as a hero of the revolution by Sandinista students.

Tasks for the visiting U.S. professors included curriculum and faculty development, inservice courses, laboratory construction, classroom teaching, course development, research supervision, applied

research, project development, and mass media presentations on project achievements. Their mission would be to make operative a new strategy for higher education where science would be translated into development activities that could be disseminated throughout the country via ministries and grassroots organizations (Aiges, 1986b; Hector , 1985).

Implementation of the Project

The experiences of the U.S. professors and their Nicaraguan colleagues at each of the campuses are summarized in FIGURE 1 following. The three professors placed at the UCA campus, a Jesuit institution and a stronghold of liberation theology, expressed enthusiasm about their opportunity to do pioneering work in applied science. The professors at UNAN, a center of Sandinista activism and thought, with less control over their activities and removed from the capital felt somewhat less effective.

(FIGURE 1 about here)

UCA visiting professors used their expertise to create new specialized curricula and projects in aquaculture, forestry and nutritional sciences. With involvement in important decisions in their departments, this group, because of close proximity to the government ministries in the capital could easily collaborate with ministry officials in planning and implementing joint projects.

The UNAN visiting professors in provincial Leon, on the other hand, experienced isolation and little flexibility in their assignments, which were not always congruent with their specializations. Rather than create new programs, they revised traditional theoretical courses in basic sciences, seeking to increase their relevance to development needs

FIGURE 1: Applied Science Projects, Linkages, and Outcomes in Nicaraguan Universities

	UCA CAMPUS			UNAN CAMPUS			
	Aquaculture/ Fisheries	Forestry & Forest Ecology	Nutritional Sciences	Bio-Chemistry, Ecological	Bio-Chemistry, Medical	Biology	Zoology
RESEARCH & DEVELOPMENT PROJECTS	o Fishpond Construction o Fishfarming in Rural Development o Fishmeal	o Cartography & Photo-interp. Lab o Forestry Inventory o Mapping Projects	o Nutritional Laboratory o Child Feeding Project o Teacher Education Project o Solar Food Dehydration o Eat Fish, TV Promotion	o Develop Ecology Lab o Ecological Survey & Training	o Nicaraguan Hereditary Disease Survey o Medical Survey o Medical Services Delivery	o Pest Control Project	o Inventory of Native Birds
LINKS TO NATIONAL AND INTERNATIONAL ORGANIZATIONS	o Ministry of Education o National Women's Association o Rural Development Agencies o Cooperatives	o Ministry of Natural Resources o Firewood Project	o Ministry of Natural Resources o Food and Agriculture Organization (FAO) o Ministry of Agriculture	o Various National Planning Agencies	o Ministry of Health	o Ministry of Agriculture	o Ministry of Agriculture
OUTCOMES	o Pioneering in Applied Science at University o Nationwide Aquaculture Capability	o More Efficient Natural Resource Management and Fuel Policies	o Improved Instruction o Improved Eating Habits o Improved Child Health	o Ecological Input in Government Development Planning	o Improved Health Knowledge o Improved Health Services Availability	o Alternatives to Imported Pesticides	o Expanded Knowledge o Improved Wildlife Management

Source: Paulston and Henderson, 1983.

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in ecological and medical biology and zoology.

Outcomes: Problems and Achievements

Specific reform achievements may be seen in an expanded and more development-oriented science curriculum. U.S. professors carried out over ten research projects, taught university extension classes, reported project activities in the mass media and on national television, and formed links with communities and government offices. In this way project impact on the universities and through dissemination activities gained widespread recognition and respect across Nicaragua.

The professors at the UCA campus in Aguaculture and Fisheries created a new practical specialization and helped the nation to link aguaculture with community development in rural areas. The faculty of Forestry created the means for more efficient natural resource management and fuel policies. Nutritional Science professors improved teacher education and formal school instruction on eating habits and child health.

On the UNAN campus, achievements related to the nation's development include the addition of an ecological impact/appraisal in governmental planning, improved health knowledge and a greater availability of health services. The Biology unit is credited with the creation of alternatives to imported pesticides. The Zoology unit provided expanded knowledge at the university level as well as an improved system of wild life management.

On both campuses, over 2,000 students received instruction through semester-long classes, laboratory experience, seminars and workshops. In addition, visiting professors guided and advised students in their

departments on theses and monographs, and presented numerous refresher courses for their Nicaraguan faculty colleagues.

LASPAU carried out two assessments; a preliminary evaluation provided the opportunity for in-progress alterations; and a final evaluation measured program outcomes. All four stakeholder groups - i.e. the Nicaraguan administrators, faculty and students, and the U.S. agencies and professors, responded favorably to both evaluations (Paulston and Henderson, 1983). The preliminary evaluation focused on three areas: the professors' adjustment to their new setting, and the progress of their academic work; suggestions for project modifications; and feedback from the professors and the Nicaraguan Universities on LASPAU's administration of the program. Despite the intensifying Reagan military intervention, LASPAU found that both U.S. and Nicaraguan professors saw their collaboration in science reform as productive, and congenial.

The final evaluation team also found persuasive evidence of a very successful program. Project goals were met and university administrators and faculty expressed strong interest in continuing the project, but only under LASPAU's auspices. The Nicaraguan rectors and department heads at UNAN and UCA showed consistent support and overall satisfaction with the project. While not criticizing LASPAU's efforts, they regreted that the project had failed to recruit professors in physics, mathematics, and computer science. University administrators and faculty saw the visiting professors' leadership and systematic, scientific approach to research as highly appropriate role behavior for UNAN professors and students in their task of revolutionary reconstruction.

LASPAU also rated the reform program a successful and productive professor exchange. It enabled them to reaffirm academic ties with Nicaragua after the 1979 revolution, and to initiate an innovative scholarship program of teacher exchange. As LASPAU'S first contribution to educational reform within a Latin American educational system, LASPAU staff worked diligently to make the project a success.

AID mission personnel provided a more guarded and confrontational assessment. While they acknowledged the projects' practical contributions, they dismissed them as but a small part of the Carter administration's misguided strategy to compete with massive technical assistance to the revolution from Communist states (Grigulevich, 1981; Schwab and Sims, 1985).

In two years, at a cost of less than one-half million dollars, the reform project produced a significant impact on the UCA and UNAN science departments. It added valuable new science courses, led to improvement in existing courses, and enhanced teacher inservice training. Outstanding collaborative research and development projects took place among U.S. and Nicaraguan professors, advanced students, and with government agencies and ministries. For the first time, Nicaragua's university students helped translate science into applied research and community projects.

LASPAU's strategy in delegating responsibility to the visiting professors played an important part in securing project goal attainment. They hired the best candidates available, and allowed them freedom and flexibility to achieve project goals of innovation and reform in context. The program's flexible organization and the high quality of

its personnel, the mid-term evaluation and resulting remedial actions, and LASPAU's intelligent and timely logistical support all worked to create a successful program.

In many ways the project serves as a model for the establishment and support of applied science in third world higher education. It had an influence on the Nicaraguan universities' physical structure, curriculum, and value orientation. The program, moreover, provided a rare opportunity for the U.S. and Nicaraguan governments to work together for a short period with mutual respect. The U.S. government supplied a limited but vital service, and an influence for democratic values. The program ended, however, because political relations between the two governments had deteriorated to such a point that the U.S. Reagan Administration, which had been elected just after the start of the project on a platform of overthrowing the Sandinista-led Nicaraguan government, refused additional funding for the LASPAU controlled project. Where the U.S. chose to work with the Sandinistas in 1979, by 1983 the policy of a new U.S. administration sought to punish the Sandinistas by denying them a highly successful project that they had hoped to continue and even expand.

Implications for Development Theory and Practice

How do we explain the success of this reform given the simultaneous U.S. military intervention in Nicaragua? We would note again the serious limitations of outside explanation via metatheoretical analysis, and suggest instead that the best explanations will be found inside in, for example, Sandino's practice of ideological pluralism as adopted and practiced by the dominant Sandinistas (Hodges, 1986). As

indicated in Figure 2 below, Sandinistas saw the reform largely from the global change ideological perspectives of revolutionary socialism and liberation theology (Cardinal, E., 1983; Noland, 1984). This provided the political will necessary to break with traditional practice and instead stress applied science for economic development. Recognizing their lack of experience and technical skills, the Sandinistas sought and engaged U.S. participants operating from modernization and grassroots development orientations to advance practice. This critical pragmatic approach worked reasonably well as long as major participants concentrated on practice and recognized the legitimate requirements of revolutionary reconstruction. When the U.S. shifted their priority from practice to ideological warfare, i.e., to dominating and eliminating the global change orientations, the collaboration ended (Fuentes, 1988).

(FIGURE 2 about here)

Cooperative assistance and mutual tolerance-between revolutionaries and U.S. academics-indeed among all the stakeholders, were key elements of the successful science program. Now that the Sandinista government has been replaced by what appears to be a more compliant government, the opportunity for programs such as the one mounted by LASPAU may become possible again. Current U.S. technical assistance policy remains wedded to modernization ideology that supports applied research and national development through higher education (Bujazan, 1987). But for a project such as LASPAU's to be successful it must also be a priority of the new Nicaraguan government, the National Opposition Union (UNO). With the return of traditional economic elites and growing political strife, prospects here are less than promising (Jimnez, 1990; Uhlig, 1990).

Figure 2 : Ideological Orientations to Nicaraguan Educational Reform Practice : A Phenomenographic Representation

GLOBAL CHANGE ORIENTATIONS
Critical Theory & Liberation Theology Theory
(ie. reform as transformation of consciousness for "empowerment" & "liberation" : Christian Marxists)
Revolutionary Socialist Theory
(ie. reform as structural transformation for "social evolution" : Sandanista and Cuban Orthodox Marxists)
REALITY VIEWED AS SOCIALLY CONSTRUCTED
REALITY VIEWED AS STRUCTURALLY DETERMINED
AS
REFORM
ACTION
Formulation
Implementation
Evaluation
Reflection
REFORM PRACTICE
Grassroots Theory
(ie. reform as cooperation and self help for "participatory development" : LASPAU, NGOS, and volunteers)
Modernization Theory
(ie. reform as structural innovation for social efficiency and "progress" : USAID)
INCREMENTAL CHANGE ORIENTATIONS

The collaborative project described here demonstrates that much can be done at reasonable cost to link applied science training, development, and extension courses to rural communities. The essential conditions, it would seem, call for a context where political will for greater equity, and applied science for enhanced productivity, can be merged in a critical pragmatic orientation to educational reform that evaluates ideas and theories against the dual standards of what is needed, and what works in practice.

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